ALTERNATIVE ENERGY IN EU - LESSONS FROM PORTUGAL

Teresa Rodrigues, Ana Campos

Portuguese Institute of International Relations, Avenida de Berna 26A, 1061-069 Lisbon, Portugal

Abstract

EU is trying to reduce its dependence of fossil energies, assure alternative energy sources, and increase its energy security. It leads a global energy transition, which involves a considerable change in consumption/production profiles, energy market, transit and security supply. Portugal has been pointed as a good case of European politics: since 2006 it reduced 12% its external dependence, betting on renewable energies (+35%), and quadrupled electricity production from renewable energy fonts. In a global insecure context it can became a strategic country in energy issues.

Key words: *European Union, Portugal, energy policy, renewable energy*

1. INTRODUCTION

In today's world energy resources are essential to ensure national and global stability and security and they are an important engine to world's economy. World's population is growing and, consequently, also the consumption and the demand for resources. However, the production of fossil fuels, which are the most relevant resources in terms of energy consumption, is decreasing. This factor is a serious challenge to energy security. There will be more consumers, higher levels of per capita consumption, and economic development will continue to be based in industry and long distance transport (Leal, 2014). The technological development and the increase of the production of renewable energy can reduce this pressure.

The European Union (EU) is a major energy importer, and is confronted with the need to moderate its structural weaknesses in the energy sector. In fact, EU has two ways to do it. A more traditional, in line with the definition of the Asia Pacific Energy Research Centre, relies on the implementation of measures to ensure security of supply and transport, as well as the diversification of suppliers (availability, accessibility, affordability, acceptability). The second involves changes in the volume and composition of the energy mix consumption, through a more sustainable model that can manage its endogenous potentialities (renewable, nuclear, electricity) (Costa, 2015).

Alongside the traditional measures, the EU is really investing in the increase of the endogenous production of renewable energy resources. The big challenge will be how to find a common response to the energy issue, as it affects differently each Member State (MS). However, all European countries seem to be rather engaged in increasing the share of renewable. This strategy can be of major importance for energy security, but it is also indispensable for ensure the future of our World. The risks of climate change and its impact are well known, and for those reasons sustainability is a great priority of the EU. Each country is doing the necessary efforts to obtain an energy transition and reach the EU's targets for 2020 and 2030, according to its own national energy framework. Portugal is one of the MS that is reaching its targets successfully, and therefore contributing for the accomplishment of EU's targets of energy policy. This is why the strategies and policies carried out by Portugal can serve as an example to Europe, as we will try to demonstrate.

This article aims to understand the EU's renewable energy approaches to ensure its energy security and Portuguese specific particularities in this process. It is divided into two parts. The first one analyses EU's reality and its position in the current process of energy global transition. The second part looks at the Portuguese case, a small country with a durable energy dependence, but that has been a "good student" to reduce its structural energy dependence, in a perspective of sustainability. What lessons can be learned by European countries, based on the Portuguese policies to consolidate a new energy mode, centered on a good manage of its endogenous resources?

2. EUROPEAN UNION'S ENERGY FRAMEWORK

The EU bet in renewable energies represents an opportunity that cannot be neglected. The EU is the World's largest energy consumer, but has few natural resources (only 1% of the natural reserves of oil, 2% of natural gas and 4% of coal), and can only ensure gross domestic consumption needs through import. This dependence on foreign producers is particularly high towards crude oil (88.2%) and natural gas (65.8%). Future scenarios predict until 2035 an increase in gas consumption and the reduction of internal supply, which will make the EU dependent on 90% of gas imports (Fernandes, 2015).

The EU's energy model is centralized and rigid, based on heavy distribution infrastructures. Europe can only minimize its current energy dependence in the medium and long term, by strengthening the coordination, cooperation and integration of its energy policy. Besides, the need for energy leads Europe to rapidly use its endogenous resources, with consequences for the future, even if the trend of reducing consumption of oil and gas is maintained. The strong focus on renewable sources will allow a substantial increase on the use of clean energy (Viana, 2014).

In relative terms, the EU MS are the World's largest energy importers (Rodrigues, 2012). After Germany and Sweden gave up the nuclear option for electricity production, the EU energy landscape seems to be structured on the growth of natural gas demand, the increase in the supply of primary renewable energy-based electricity, the reduction of liquid fuels in the transport sector, and the growing efficiency of the engines and other new technologies associated with hybrid and electric powertrains. To mitigate this situation, the EU has granted to the liberalization of the oil industry and progressive advance towards a single market for gas (Boussena e Locatelli, 2013).

The response to boost energy security in the EU had its enhanced moment with the initiatives of the Energy Union and the Common Energy Market. But those initiatives faced several obstacles, whether caused by market dominance by a few large companies, differences in national energy policies, and the lack of a common strategy. Despite them, the EU primary production covers only 34.1% and 11.7 of the consumption needs of oil and natural gas, respectively (Eurostat, 2014e).

Thus, we should consider the following trends in the general framework of the EU for the next two decades (BP, 2017; Silva, 2015):

- the mix of energy supply and the situation of dependence on oil and gas imports won't change;
- renewable energy alternatives will remain a small percentage in the energy mix;
- although consumption will continue to decrease, it will keep on being higher than endogenous production (4 times more in the case of oil, 2 times more in the case of gas);
- a common energy policy will keep on facing obstacles, given the existing differences between Central and Eastern Europe and Atlantic Europe's frameworks.

The future looks troubling. The solution to boost mutual synergies, dispute the segment of electric and thermal generation and the World's transport system may rest on on a new energy paradigm that combines gas (the cleanest of all fossil fuels) with renewable energy (Silva, 2015). This option might mitigate climate change impacts, but it will only happen if it also proves to be profitable in terms of price, competitiveness, and efficiency.

2.1. Energy dependence: a challenge to EU's energy security

Energy security is currently a high priority of States and International organizations' policy, as energy resources are one of the most important elements for nowadays society. Energy is indispensable for the proper functioning of any country at many levels, from commerce, industry or public services, and it is crucial to national stability. The risk of disruption in supply would jeopardize States and society's functioning models and reduce security.

In fact, security of supply is one of the key elements of the EU's energy security policy. The EU defines energy security as "to ensure, for the well-being of its citizens and the proper functioning of the economy, the uninterrupted physical availability of energy products on the market, at a price which is affordable for all consumers (private and industrial), while respecting environmental concerns and

looking towards sustainable development, as enshrined in Articles 2 and 6 of the Treaty on European Union" (EC, 2001). This definition embraces the four A's of energy security by APERC (2007): availability; accessibility; affordability and acceptability. Availability is about the geological capacity and resource reserves; accessibility is often conditioned by factors of a geopolitical nature and investment in necessary infrastructure for the exploitation of energy resources, which be limited by lack of funding, transport costs or access to advanced technology; affordability depends on the stability of resource prices and the cost of extraction and exploitation; and acceptability is aimed at minimizing the environmental impacts arising from the exploration of energy resources.

The EU's strategy to guarantee its energy security is based on three interconnected main purposes:

1. Secure energy supplies to ensure the reliable provision of energy, whenever and wherever it is needed;
2. Guarantee that energy providers operate in a competitive environment that ensures affordable prices for homes, businesses, and industries;
3. Ensure the sustainability of energy consumption, through the lowering of greenhouse gas emissions, pollution, and fossil fuel dependence (European Commission, 2017f).

The demand for energy has been growing in the last years, mainly in countries with a high level of population growth as China and India, but also in European countries. However, the European production of fossil fuels has not kept up with the demand and continues to decrease (only from 2013 to 2014 gas production decreased 11.2%), which lead to an increase on import volumes (Eurostat, 2016). The EU total import bill is more than €1 billion per day (European Commission, 2017e).

So, although not significantly EU's energy dependence continues to increase (from 52.2 to 53.4% between 2005 and 2014), with huge national discrepancies in dependence levels. In 2014 Belgium, Ireland, Cyprus, Luxembourg and Malta are some of the EU-28 countries with the highest share of energy dependence (between 80% and 97%); in contrast, Czech Republic, Estonia, Romania and Iceland have the lowest share of energy dependence (below 20%) (Eurostat, 2016). Thus, energy dependence remains as one of the biggest challenges to EU's energy security.

2.2. EU's energy policy and the renewable energy production

The increase of renewable energy resources production is an important strategy to ensure EU's energy security, as in the long run it will allow it to reduce imported energy and fossil fuels, one of its main vulnerabilities. The improvement of renewable energy production will also encourage economic dynamics (the turnover of the renewables industry was €144 billion in 2014), create jobs (more than one million jobs in 2014), stimulate technologic research, improve air quality, spread green and sustainable growth, and make Europe safer and more competitive, with access to affordable and clean energy (European Commission, 2017g).

Until 2030 the EU expects to accomplish six main objectives: (1) connect networks and unite the EU's power when negotiating with non EU countries; (2) diversify energy sources; (3) reduce the EU's dependence on energy imports; (4) reduce by 27% or more Europe's energy use; (5) cut at least 40% of greenhouse gases emission; (6) be recognized World's number one in renewable energy and a leader in the fight against global warming. Significant advances have already been done, such as a policy framework for energy and climate for 2030, and the integration of an EU energy market is almost a reality (European Commission, 2017c).

In order to achieve its future goals, the EU aims to consolidate the European Energy Union and its five dimensions: (*i*) energy security; (*ii*) internal energy market; (*iii*) energy efficiency; (*iv*) decarbonisation; (*v*) research, innovation and competitiveness. It is success will guarantee to all MS the free flow of energy across borders and a secure supply, leading to a sustainable, low carbon and environmentally friendly economy (European Commission, 2017i).

The contribute of renewable energy production to each of the five dimensions of the Energy Union can be systematized as follows, although the EU defined specific long-term targets for 2020, 2030 and 2050 (European Commission, 2017g):

- Energy security: using more renewables resulted in a €16 billion saving in fossil fuel imports in 2015, and this is projected to rise to €58 billion in 2030.
- Market integration: cheaper technologies and new proposals under the Commission's 'Clean Energy for all Europeans' package will further enable renewables to participate in markets on an equal footing with other energy sources.
- Energy efficiency: renewable power could help reduce primary energy consumption and improve energy performance of buildings.
- Decarbonisation: in 2015, renewables contributed to reducing greenhouse gas emissions by the equivalent of Italy's total emissions.
- Innovation: the EU has 30% of global patents in renewables, and is committed to prioritising research and innovation to further drive the energy transition

The EU wants to be a sustainable society though the implementation of a successful energy transition and be in the forefront in the combat to climate change and air pollution. It aims as well to reduce its dependence on foreign fossil fuels, and keep energy affordable for consumers and businesses. To make these goals possible, EU defined some long-term targets for 2020, 2030 and 2050:

2020 Targets

- Cut 20% in greenhouse gas emissions (from 1990 levels);
- Increase in 20% the share of renewables in the EU's energy consumption;
- Improve in 20% EU's energy efficiency
- All countries must achieve a 10% share of renewables in the transport sector (European Commission, 2017a).

The EU emissions trading system (EU ETS) is a cornerstone of the EU's policy to combat climate change and a key tool for reducing greenhouse gas emissions cost-effectively. The target is to reduce by 21% the greenhouse gas emissions from the power and industry sectors until 2020 (European Commission, 2017j). The Effort Sharing Decision sets national emission targets for 2020, expressed as percentage changes from 2005 levels. European countries agreed to reduce the greenhouse gas emission from sectors such as housing, agriculture, waste and transport (excluding aviation). However, the targets differ per national wealth, from a 20% cut for the richest countries to a maximum 20% increase for the least wealthy one. Bulgaria and Croatia, which joined the EU on 1 July 2013, can increase emissions by 11% (European Commission, 2017d).

These targets are based on an energy strategy focuses on five priorities:

1. Achieving an energy-efficient Europe;
2. Building a truly pan-European integrated energy market;
3. Empowering consumers and achieving the highest level of safety and security;
4. Extending Europe's leadership in energy technology and innovation;
5. Strengthening the external dimension of the EU energy market.

2030 Targets

- Cut 40% in greenhouse gas emissions compared to 1990 levels;
- Increase at least a 27% share of renewable energy consumption;
- Increase at least 27% energy savings compared with the business-as-usual scenario;

- Complete the internal energy market by reaching an electricity interconnection target of 15% between EU countries and pushing forward important infrastructure projects.

The EU's strategies to reach these targets are:

1. A reformed EU emissions trading scheme (ETS)
2. New indicators for the competitiveness and security of the energy system, such as price differences with major trading partners, diversification of supply, and interconnection capacity between EU countries
3. First ideas for a new governance system based on national plans for competitive, secure, and sustainable energy. These plans will follow a common EU approach. They will ensure stronger investor certainty, greater transparency, enhanced policy coherence and improved coordination across the EU (European Commission, 2017b).

2.3. Current EU's progress in renewable energy

Since 2005 until 2014 the share of energy from renewable sources in gross final consumption of energy increased from 9 to 16.0% (**Fig.1**) and these data evidences a major progress towards the Europe 2020 average target of 20%. In 2014 renewable energy sources accounted for a 12.5% share of the EU's gross inland energy consumption. In national terms the importance of renewables in gross inland consumption was relatively high in Austria (30.0%), Finland (29.4%), Denmark (26.2%), and Portugal (25.0%), exceeded one third of inland consumption in Sweden (35.8 %) and Latvia (36.2 %). In Norway, the rate was 44.8% and in Iceland reached 86.3%! Solid biofuels and renewable waste were the most important source (63.1 %), followed by hydropower (16.5%), wind energy (11.1 %), wind and solar energy (6.1%), and geothermal energy (3.2 %) (Eurostat, 2016). (Eurostat, 2016).

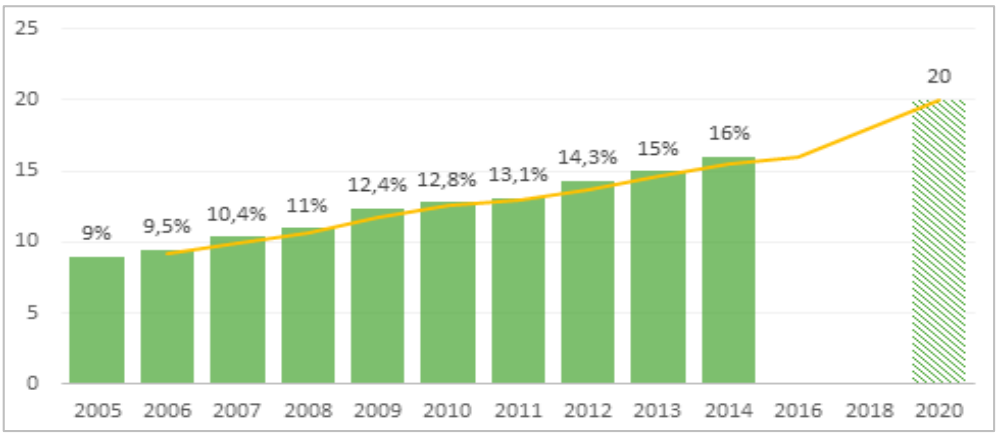

Fig.1. Share of renewable sources in energy gross final consumption, 2005-2014 (%) (Eurostat, 2016).

As it happened with primary consumption, on the transport sector the EU also assumed an explicit target for each MS, such as in 2020 renewable energy sources should account for at least 10% of all used fuel However, in 2014 the average share of renewable energy sources in transport fuel consumption across the EU was only 5.9% (**Fig.2**), ranging from a maximum of 21.6 and 19.2% in Finland and Sweden (the only MS with double-digit shares), to less than 1.0% in Spain and Estonia (Eurostat, 2016).

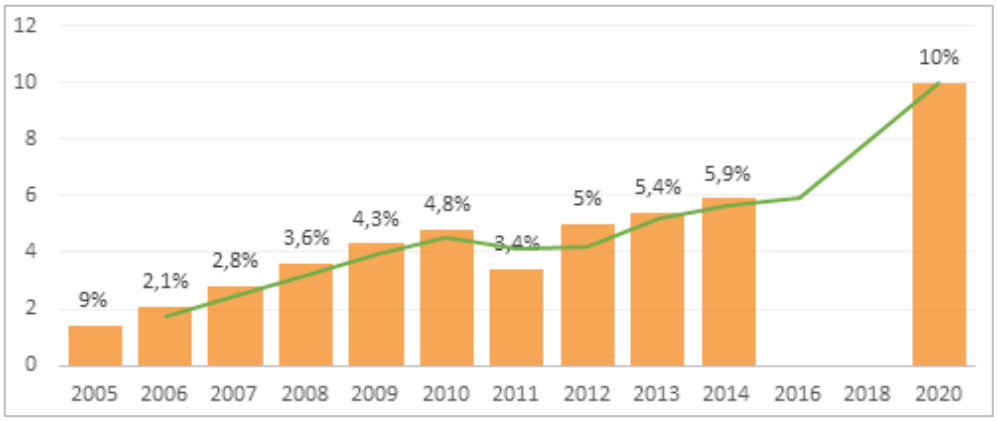

Fig.2. Share of renewable energy sources in transport 2005-2014 (%) (Source: Eurostat, 2016).

The EU28 has made efforts to accomplish the targets established up to 2020, and all countries, according with its national targets, are involved in the objective of increasing the share of renewable resources. In spite of all EU's MS have assumed the purpose of increase progress towards 2020 targets in renewable energy share, the levels of success seem quite variable and we can observe differences in each national target, with 13 countries surpassing the 20%, with the highest share belonging to Sweden (52.6%), followed by Finland and Latvia (38.7%) and Austria (33.1%). The others 15 members are less optimistic as Luxemburg (with 4.5%), Malta (4.7%) or Belgium (8%). (Eurostat, 2016). With 27% of share of renewables (national target is 31%), Portugal is well above average, when compared to the EU's average of 13-16% (European Commission, 2017h).

Even considering this panorama it seems that EU can have an optimistic perspective for the future and it will possible to achieve the targets for 2030. Of course, this will request a tough effort of all MS and a coordinate energy policy.

3. PORTUGAL AND THE SUSTAINABILITY OF ENDOGENOUS RESOURCES

According to national different available resources and own unique energy markets, each MS will have to follow distinctive paths when it comes to meet its obligations under the Renewable Energy Directive, including they're legally binding 2020 targets. Though all EU countries have domestic renewable energy resources to explore, some have a greater potential for renewables than others, depending on their specific climate and morphologic conditions. Wind or river flows intensity can assure different levels of suitability for eolic or hydroelectric power, while others may have yearly sunshine, better suitable for solar energy.

Portugal has privileged conditions (sun, wind, water), and so significant endogenous opportunities. It also has scarce endogenous energy resources of oil, gas and coal (Silva, 2012) (**Fig.3**).

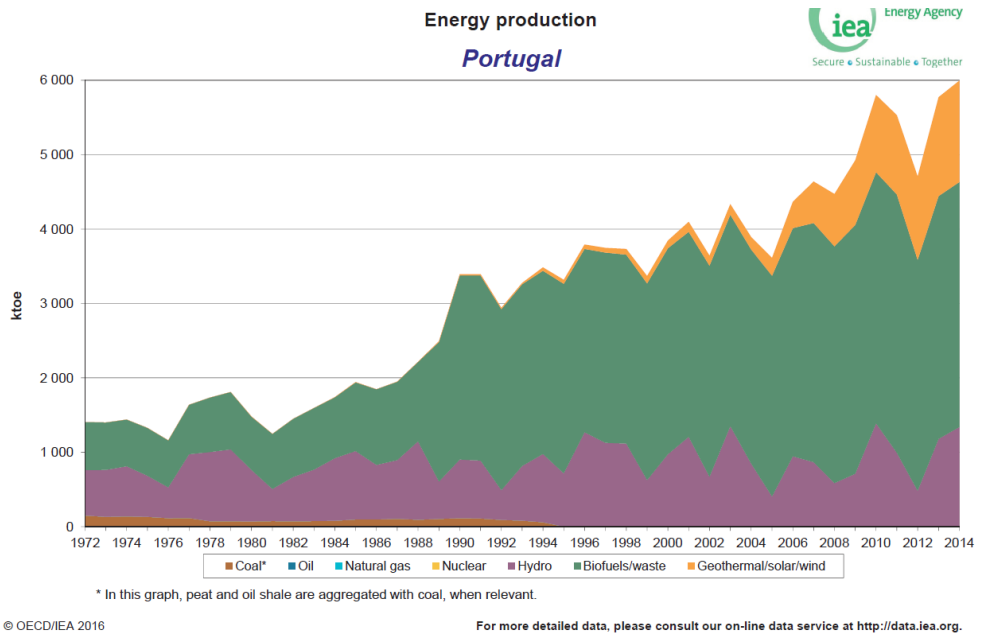

Fig.3. Portugal. Energy production by fuel (1972-2014) (IEA, 2016)

Oil occupies a central position between the various energy sources and has an excessive weight in total primary energy (more than 45%), although the consumption levels are decreasing since 2005. The introduction of natural gas in 1997 made it possible to diversify the structure of the energy supply and reduce external dependence in relation to oil. Since then, there has been a positive evolution in the energy mix, representing today the natural gas about of 20% of total primary energy consumption. Coal consumption tends to decline, and so its weight in the production of electricity, due to its impact on CO2 emissions. Reverse trend feature renewable energy, which position in total primary energy consumption doubled in just 10 years (from 13 to 26% between 2004 and 2014) (DGEG, 2014) (**Fig.4**).

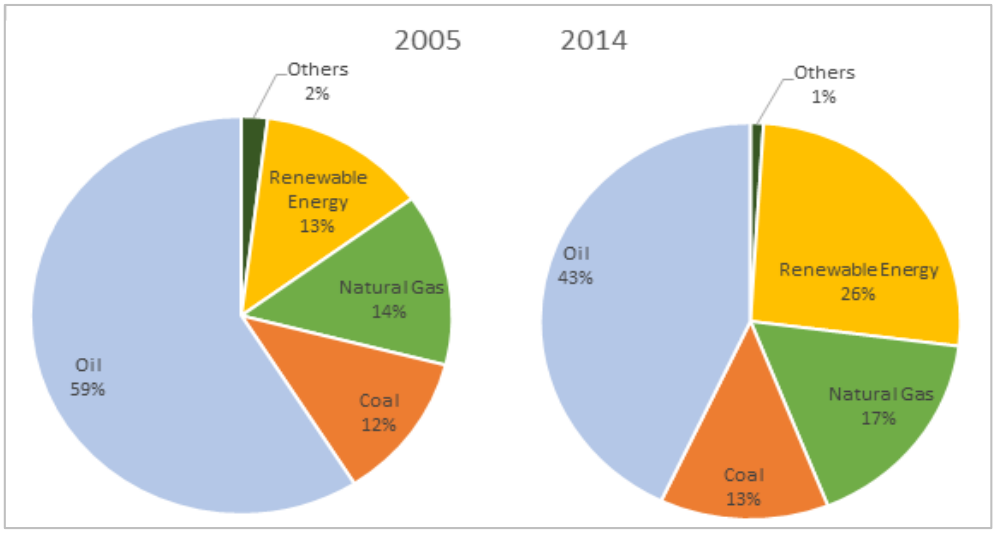

Fig.4. Portugal. Evolution of primary energy consumption (2005 and 2014) (DGEG, 2014)

3.1. The Portuguese energy dependence

Some of the main goals of Portuguese political energy options are: (i) the reduction of the energy balance imports; (ii) the fulfilment of the commitments made at European level and within the framework of the Kyoto Protocol; (iii) the promotion of renewable energy and sustainable development. All these objectives are in line with the objectives of EU energy policy.

The success of these options is stated by facts and numbers: in the last decade Portugal could reduce its external dependency through 1) energy efficiency improvement, 2) an increase of endogenous production, and 3) the success of environmental sustainability option. The country has also gambled on diversification of suppliers to reduce its vulnerability about energy supply (European Commission, 2017l). Let's now take a better look to each of these vectors.

Energy efficiency improvements - Since 2008 Portugal has been developing an energy policy strategically directed to improve internal energy efficiency, promote renewable energy and reduce carbon emissions, providing "green" investment in the energy sector (IEA, 2016). The most relevant measures and incentive programs to promote energy efficiency are the following:

2006 - *Fundo Português de Carbono* (Decreto-Lei nº71/2006) aims to limit carbon emissions by obtaining credits for greenhouse gas emissions; and give support to projects that contribute to reduce emissions of greenhouse gases, increase energy efficiency and develop practical renewable energy projects;

2010 – *ENE 2020-Estratégia Nacional para a Energia* 2020 (RCM n.º29/2010);

2010 – *FEE-Fundo de Eficiência Energética* (Decreto-Lei nº50/2010) aims to encourage the measures of the national action plan for energy efficiency (PNAEE);

2014 - *Reforma da Fiscalidade Verde* (Lei nº82-D/2014) changes a set of environmental tax rules in the energy sector and emissions (Gomes, 2016).

The Portuguese policy on energy is mainly based on the National Energy Strategy 2020 organized into five main axis in line with the force guidelines of the Government strategy for energy (**Fig.5**).

Fig. 5. The Portuguese Energy strategy (ENE 2020, 2010)

The current Government considers efficiency the highest priority of the national energy policy, and the reduction of average energy consumption a priority (25% until 2020, 30% until 2030). To reduce external dependence, it encourages and promotes the use of renewable energies, the restructuring of the fuel sector, the reinforcement of sustainable mobility, and the development of national endogenous potential. In accordance, some measures were undertaken and population daily collective behaviors were changed. In 2014, Portugal was the 4th EU country with the lowest per capita primary energy consumption (domestic production represented 28% of total consumption) and was the 7th country with the lowest per capita final energy consumption (DGEG, 2014).

To achieve the identified goals political responsible defined as strategies: (i) to reduce the weight of the final energy consumption in GDP, by promoting greater efficiency of public administration, companies and individual behaviors of citizens; (ii) to stimulate greater competition in the marketing of electricity and gas, particularly by encouraging the emergence of new economic players and differentiated and innovative commercial offerings adjusted to different types of consumption; (iii) to encourage the development of intelligent electric networks (smart grids) and ensure, gradually and progressively, the installation of smart meters (smart meters). The reduction of costs in the electric sectors of natural gas and fuel production, in terms of transport, distribution and marketing, is considered essential to reduce both public and domestic consumers' energy bill, and increase national enterprises competitiveness.

As an example of good practices, the Political Program of the 21st Constitutional Government states the commitment to reduce in all Ministry 30% of the total consumption of electricity and fuel (spent mostly with buildings and taskforces), and promote fuel switching initiatives (by companies producing transactional goods), thus generating meaningful energy savings. It also recognizes the need of investment on "scientific research applied as clean technologies and new methods of production of electricity from renewable energy sources" and "in the relationship between the industry and I&D institutions to produce energy storage solutions" (RP, 2015).

Increase of endogenous production – The increase of endogenous resources production is essential to ensure energy security and to try to counter the strong dependence on imports of energy resources. Once Portugal does not produce or explore fossil resources that bet was weak, under the renewable energies. The country has a territory with a huge diversity of renewable energy resources (rivers, sun, wind, waves and biomass), and great conditions for the exploitation of these resources due to high sunlight exposure and hydrographic network density. There is therefore a strong effort to invest in wind farms and dams. Portugal also tries to decrease the use of fossil fuels and increase the use of clean and renewable energies, in order to reduce greenhouse gas emissions and comply with its commitments vis-à-vis the EU and the Kyoto Protocol.

Aiming to get a progressive independence vis-à-vis fossil fuels the Portuguese Government set in 2010 the goal to reduce until 2020 by 74% energy dependency producing then from endogenous resources the equivalent to 60 million barrels/oil/year (Resolução AR, 2010). In fact, the Portuguese energy dependency is already declining for more than a decade, except for 2005, a year of drought, which reduced the internal hydropower production. Data from Direção-geral de Energia e Geologia (DGEG) estimate the national energy dependency in 2014 at 72.4%, the 9th most energy dependent in the ranking of the EU countries. This means that in four years, Portugal managed to achieve and exceed the goal it had set for 2020. The reduction was mainly due to a 4%, reduction of the balance energy imports due to an increase in the production of electricity from renewable energy (DGEG, 2014) (**Fig.6**).

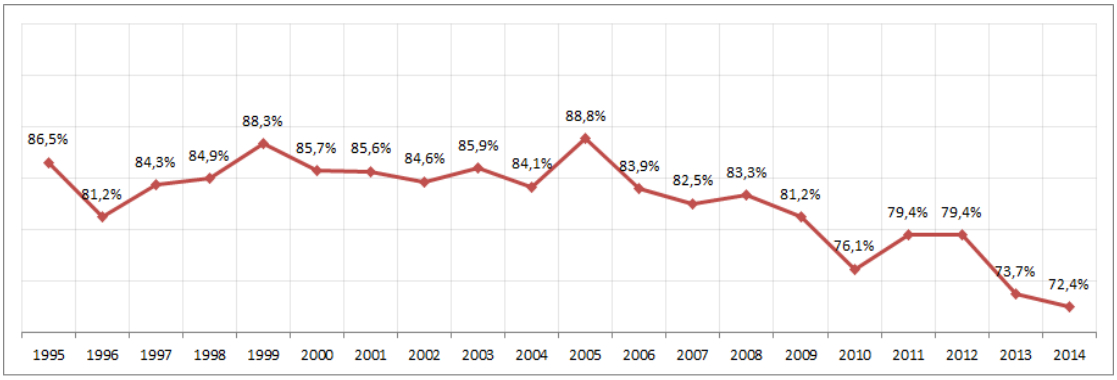

Fig 6. Portugal. Evolution of energy dependence (1995-2014) (%) (DGEG, 2014).

Another goal set by the Government within the framework of the National Strategy for energy 2020 was to deduce in 25% (€2 billion euros) the balance of imported energy, replaced by electricity generated from endogenous sources generating (Resolução AR, 2010). From 2014 to 2015, the balance of energy products imports stood at €3.693 million, a decrease of 35.6% due to endogenous production (DGEG, 2015) (**Fig.7**).

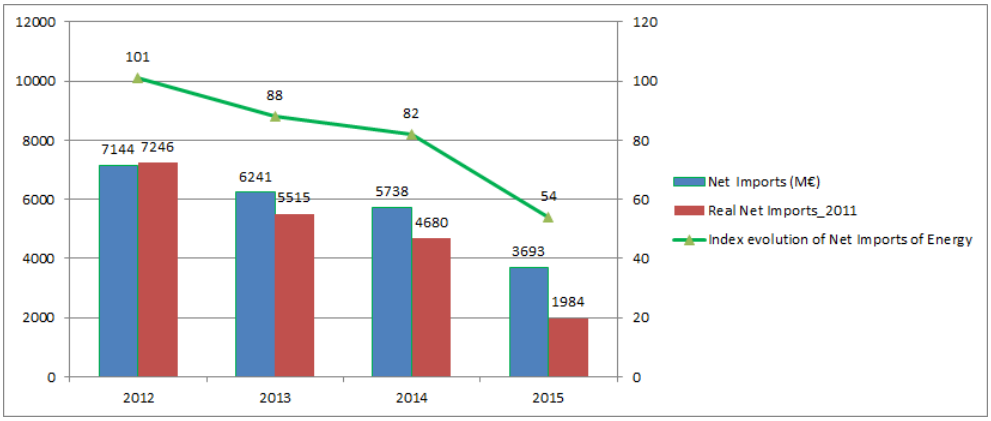

Fig 7. Portugal. Imports balance of Energy Products (DGEG, 2015).

3.2. "The renewable option"

Today Portugal occupies the seventh position in the EU-28, 11 points above the average (16.0%), which demonstrates its good performance under the renewables Directive and in terms of fulfilment of the targets for 2020 (DGEG, 2014).

The development in production and diversification of renewable energy sources has been a high priority of Portuguese energy policy. Portugal has fulfilled the targets identified by the EU in 2009 and 2013 concerning the obligation for all MS to have a plan to promote the use of energy from renewable sources (RES) (Directive 28/2009/CE, 23 April 2009; RCM n. º20/2013). The goal for Portugal is to reach 31% from renewable sources in 2020. But in 2014 the RES already accounted for 27%, which means that Portugal has already reached 87% of its goal for 2020. In the transport sector (RES-T) the goal is 10% for 2020 and reached 3.4% in 2014, a value still lower than the desired. In the total electricity consumption, renewables accounted for 52.1% (DGEG, 2014).

Portugal has been rising almost steadily the incorporation of renewable energy sources in energy gross final consumption, and is getting closer to the agreed targets (**Fig.8**). According to the program of the 21st constitutional Government (RP, 2015), the goal until 2030 will be to reach a share of at least 40%

from renewable sources in final market of energy consumption. The argument is that "it is possible to take advantage of our renewable potential without harming the financial sustainability of the energy system, or the competitiveness of the economy, especially if we consider the green energy as a product of export".

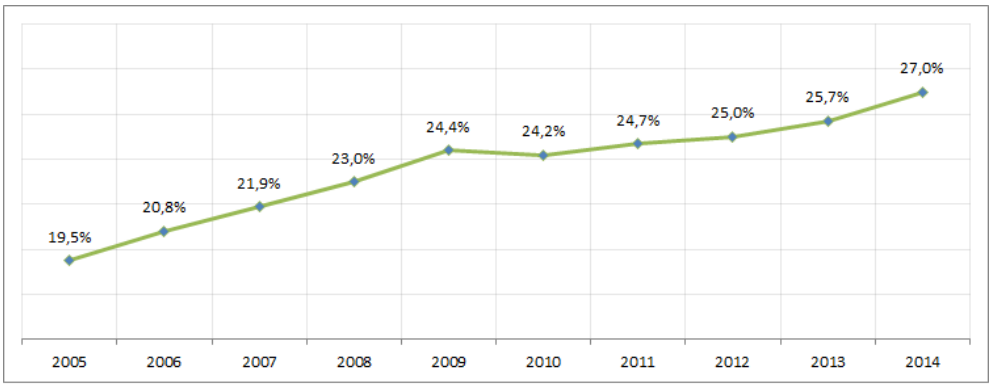

Fig 8. Portugal. Height of renewable energies in gross final consumption (%) (DGEG, 2014).

In 2015, the renewable energy sources contributed with 48.2% of the total electricity consumed in Portugal (Boletim das ER, 2015), and from January to August 2016 with 64% of all national electricity production, being the main sources hydropower (36%) and wind (22%) (Boletim das ER, 2016) (**Fig.9**). but despite the strong investment in renewable energies, fossil resources continue to have a big weight in the final energy consumption (**Fig.10**). Oil continues to represent about half of the total consumption, while renewables represent only 7%. In 2014, transport was the sector that consumes more energy (36%), followed by the industry, with 31%, and domestic consumption, which represents 17% of total consumption. Although there is a strong focus in renewable energies, in particular regarding electricity, they are still far from replacing natural gas, much less oil as major energy sources (Rodrigues, Campos, 2017).

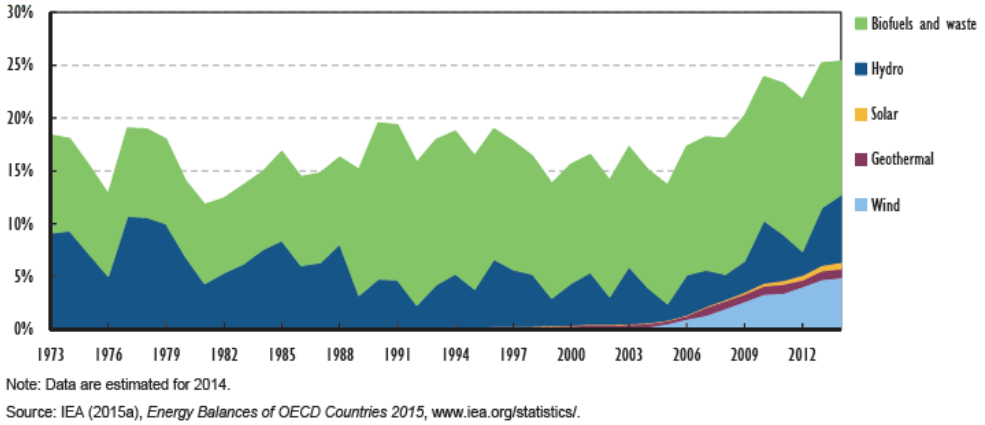

Fig 9. Renewable energy as a percentage of TPES, 1973-2014 (IEA, 2016)

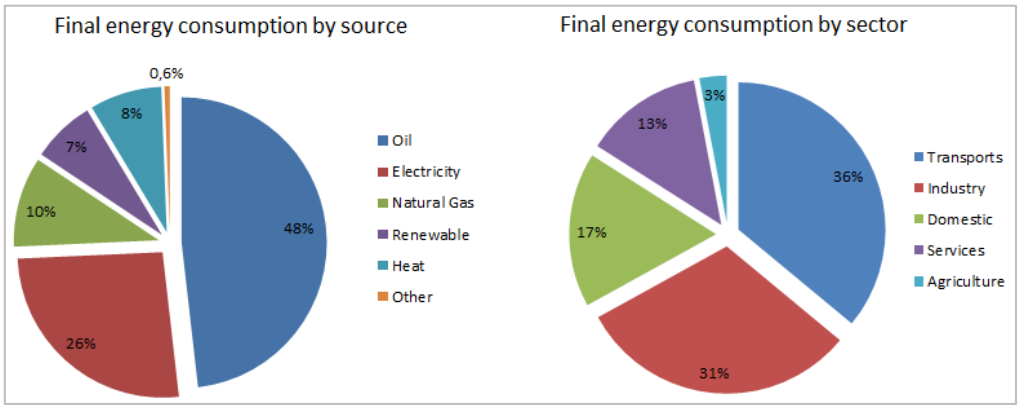

Fig 10. Final energy consumption by source and sector (DGEG, 2014).

There is still a long way to go. Nevertheless, not only at European level but also in global terms Portugal occupies a very prominent position regarding the sector of renewable energies. In 2014 it stood as the 7th IEA's member state on the percentage of renewable energies in total primary energy supply (TPES), (with 27%) ahead of some of the world's largest economic powers, such as USA, Germany, France or United Kingdom (**Fig.11**). The same happens when we compare the IEA member countries ranking on electricity generation from renewable sources, where Portugal is the 5th country, with a percentage above the 60% of all generation (**Fig.12**) (IEA, 2016). In both cases the most significant resources are hydro and wind, most particularly concerning electricity production. Solar e geothermal energy is not so used, although the country has climatic conditions very propitious to develop that endogenous source, but lacks technological investment, namely to increase storage capacity.

Solar and geothermal might represent a window of opportunity. During the month of May 2016, Portugal cater the country's power grid for 107 hours only using renewable energy (solar, wind and hydro), a positive sign of progress in the development of renewable energy production. This bet is very important at various levels, as it contributes to reduce greenhouse gas emissions and the need for imports, while it increases energy bill savings (Observador, 2016).

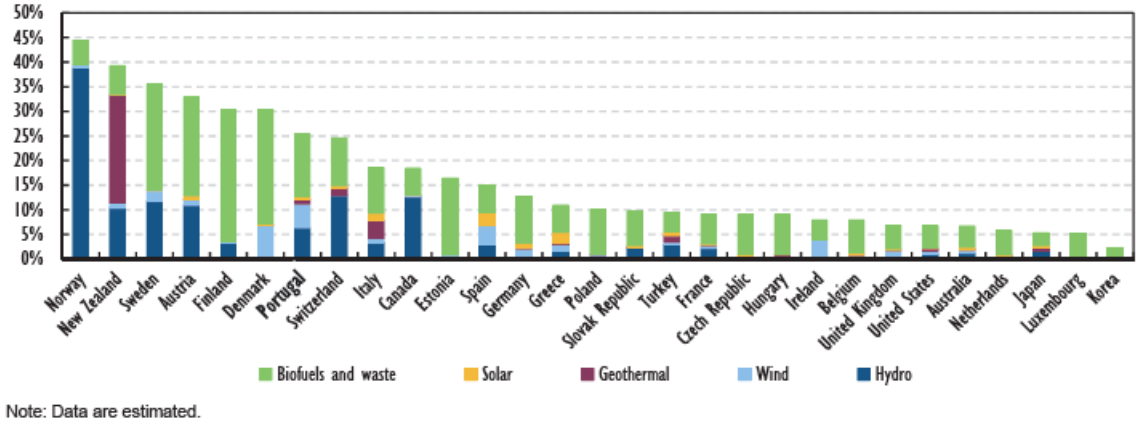

Fig 11. Portugal and IEA member countries. Renewable energy as a % of TPES, 2014 (IEA, 2016)

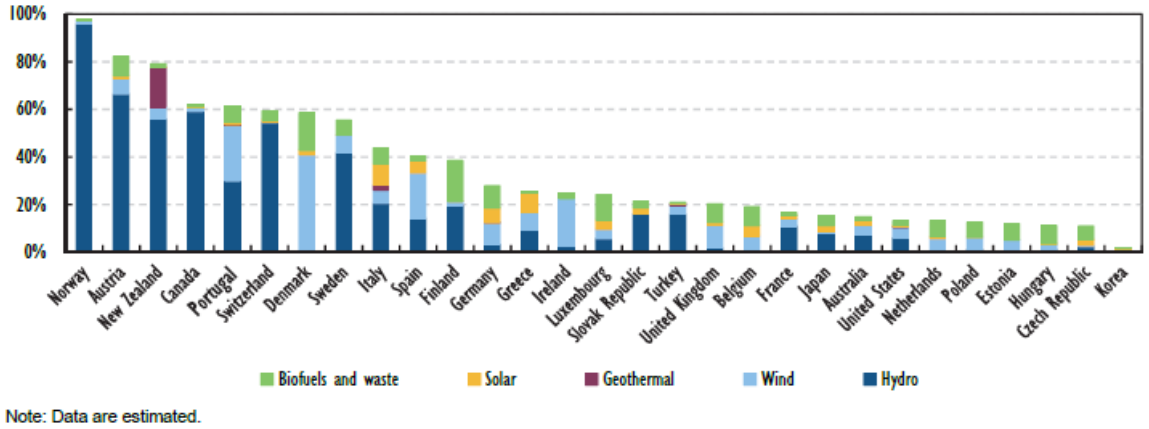

Fig 12. Portugal and IEA member countries. Electricity generation from renewable sources as a % of all generation, 2014 (IEA, 2016)

4. FINAL REMARKS

It seems clear that energy dependence is a serious vulnerability to EU's energy security. The EU is aware of it but it is crucial to develop strategies in order to fill this gap, and it has been developing important short-term measures to deal with an eventual disruption in supply. However, there are still some fragilities in security of supply that EU may not be prepared to deal successfully with.

Besides, long-term measures are fundamental to ensure a more promising future in energy issue. At long-term level, the investment in the increase of the production of renewable energy resources may be the determinant and reliable. On the one hand renewable energy reduces the dependence on fossil fuels, on the other hand it represents also an important component to reduce the impact of climate changes and contribute to a safety future. Among others, these two factors explain why the increase of renewable production must be the chosen as number one's strategy.

Renewables are crucial for Europe's energy security and their estimated contribution to fossil fuel import savings in 2015 in the EU was €16bn. By 2030 it is projected to be €58bn.Tough the high costs of renewable energy production and storage can be an obstacle to the achievement of common goals, EU has set a line of funding for each MS to develop national production and its efforts in promoting the use of renewables have resulted in lowered costs. Several renewable technologies have now become cost-competitive, and can in some cases be even cheaper than fossil fuels. Today the renewable energy sector plays a key role in the EU economy, with a turnover of around €144bn in 2014 and more than one million people employed (EC, 2017m).

The EU is aware of the risks of climate changes and its economic costs, and all European countries are committed to the European energy agenda. Despite of all the differences between MS, they share common values and goals regarding renewable energy. Although the level of progress among them is quite different, it seems that the EU will achieve its goals for 2020.

Are these possible changes? And how they may influence the future? Energy dependence will remain for the next decades as one major challenge to EU's energy security and only an EU's consistent energy policy, based on renewable energy production can fulfil the need of energy consumption in a sustainable way. Although currently EU's progress on renewable energy is a reality, there is still a long way to run in what concerns common policies. Responses for this collective challenge face different realities.

So, what lessons can be learned by some European countries based on the implemented Portuguese policies to consolidate a new energy model centered on a good manage of its endogenous resources?

Portugal is a small and periphery country that have a huge dependence of energy imports and where fossil fuels dominate consumption patterns. Unlike others EU's MS, Portugal does not produce any kind of fossil fuels to satisfy its needs. However, Portugal is aware of its heavily vulnerability and does not

continue to be so dependent. In order to solve this problem, Portugal embraced the EU's energy policy and the targets of a more sustainable future in a persistent and national way.

Portugal's energy policy is committed both to the EU policy and to the Kyoto Protocol. For this reason, environmental sustainability and energy efficiency have a great influence in the formulation of strategies. Portugal show a strong commitment to the renewable energy development and has been successful in that strategic purpose. In just a decade renewable energies increased in production and consumption, especially for electricity production. In addition, Portugal fulfilled the goals that it had established for 2020, and is close to attain most of its targets. This commitment to produce renewable energies is vital to strengthen security of supply, diversify the energy mix and ensure sustainability. In 2014 Portugal ranked 7th out of the 28 EU countries in with regard to the targets to 2020 and the integration of renewable energy sources.

An academic study about the future of Portuguese energy security (Rodrigues, 2012), designed four possible scenarios for the future of energy issue, one of which relies on the success of renewables as the best suited to mitigate national energy vulnerabilities, including the structural external dependency of fossil energy resources (*Scenario 4 – Green but cautious*). For this scenario to happen various assumptions must be gathered, some of them still unpredictable (Rodrigues, Campos, 2017):

Green but cautious

Portugal would reinforce as a political priority the bet in renewables, supported by a big European project led by Germany. This project would turn the South of the Iberian Peninsula and North Africa in the main spot of solar thermal electricity production (*project DESERTEC*). Based on German investment, Portugal would become the major supplier of glass components for this project;

Portugal would use the 2014/2020 structural funds to transform its energy system in a radical decarbonization trajectory without recourse to nuclear, becoming a reference model for the German ecologists who would be the largest political party in Germany;

The bet on sustainability reveals a transformation of Portuguese economy, based on the production of biological food, and on the provision of services (tourism and health) for all MS;

Centralized electricity production based on natural gas would be complementary to the national electric system, and not as relevant as expected.

Hydroelectric production would be enhanced, as well as local network transfer of part of the offer for residential use accompanied by coverage by smart grids;

Portugal would halt and reduce the use of fuel in urban transport sector, thanks to the early diffusion of electric vehicles for individual and collective public transport. These vehicles would use hydrogen fuel cells obtained by wind and wave electricity, created in partnership with Japan and France;

The Alliance with Brazil (PETROBRAS) and France (TOTAL) in the oil sector would make it possible to ensure supply;

Portugal could attract the United Arab Emirates as financial supporters of Portuguese of Electricity Company based on natural gas;

Although less and less dependent on oil, Portugal will contribute to ensure the Mediterranean and the Middle East security.

Besides of all the legislation, Portugal is trying to act in the field of collective behaviors through campaigns in the schools and mass media that can disseminate general information and useful advices about how to consume efficiently and the advantages of choosing renewable energy. Change the mentalities and behaviors is an important part in order to change consumption patterns and reduce ecological footprint and savings. These can reduce and change the kind of necessities faster and in sustainable way.

REFERENCES

2013. Conceito Estratégico de Defesa Nacional. Resolução do Conselho de Ministros n.º 19/2013. [pdf] Available at: <https://www.defesa.pt/Documents/20130405_CM_CEDN.pdf> [Accessed at 30 January 2017].

APERC. 2007. A Quest for Energy Security in the 21st Century. [pdf] Available at: <http://aperc.ieej.or.jp/file/2010/9/26/APERC_2007_A_Quest_for_Energy_Security.pdf> [Accessed at 16 March 2017].

Boussena, S. and Locatelli, C., 2013. Energy institutional and organisational changes in EU and Russia: Revisiting gas relations. *Energy Policy*, 55, 180-189. [pdf] Available at: <http://dx.doi.org/10.1016/j.enpol.2012.11.052> [Accessed at 5 March 2017].

BP. 2016. Statistical Review of World Energy June 2016 [pdf] Available at: <https://www.bp.com/content/dam/bp/pdf/energy-economics/statistical-review-2016/bp-statistical-review-of-world-energy-2016-full-report.pdf> [Accessed at 23 February 2017].

BP. 2017. Energy Outlook, 2017 Edition. [pdf] Available at: <https://www.bp.com/content/dam/bp/pdf/energy-economics/energy-outlook-2017/bp-energy-outlook-2017.pdf> [Accessed at 30 January 2017].

COFACE. 2016. Country Risk Assessment Map - 2nd Quarter 2016. [pdf] Available at: <http://www.coface.com/News-Publications/Publications/Country-risk-assessment-map-2nd-quarter-20162> [Accessed at 30 January 2017].

DGEG. 2014. Energia em Portugal. Direção-Geral de Energia e Geologia. [online] Available at: <http://www.dgeg.pt/> [Accessed at 31 January 2017].

DGEG. 2015. Fatura Energética Portuguesa. Direção-Geral de Energia e Geologia. [online] Available at: <http://www.dgeg.pt/> [Accessed at 31 January 2017].

DGEG, Balanço Energético Sintético 2014, Lisboa [pdf] Available at: <http://www.dgeg.pt/> [Accessed at 31 January 2017].

DGEG, Boletim das Energias Renováveis, 2015, Lisboa [pdf] Available at: <http://www.dgeg.pt/> [Accessed at 31 January 2017].

DGEG, Boletim das Energias Renováveis, 2016, Lisboa [pdf] Available at: <http://www.dgeg.pt/> [Accessed at 31 January 2017].

ENE 2020, Estratégia Nacional para a Energia [online] Available at: <http://www.apren.pt/pt/dadostecnicos/index.php?id=206&cat=197> [Accessed at 15 March 2017].

European Commission. 2001. Green Paper. Towards a European Strategy for the Security of Energy Supply. Office for UE Official Publications [pdf] Available at: <http://iet.jrc.ec.europa.eu/energyefficiency/sites/energyefficiency/files/livre-vert-en.pdf> [Accessed at 15 March 2017].

European Commission. 2011. Energy 2020 - A strategy for competitive, sustainable and secure energy [pdf] Available at: <https://ec.europa.eu/energy/sites/ener/files/documents/2011_energy2020_en_0.pdf> [Accessed at 20 March 2017].

European Commission. 2017a. 2020 Climate & Energy Package [online] Available at: <https://ec.europa.eu/clima/policies/strategies/2020_en> [Accessed at 20 March 201].

European Commission. 2017b. 2030 Energy Strategy [online] Available at: <https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2030-energy-strategy> [Accessed at 20 March 2017].

European Commission. 2017c. Commission Priorities - Energy Union and Climate [online] Available at: <https://ec.europa.eu/commission/priorities/energy-union-and-climate_en> [Accessed at 20 March 2017].

European Commission, 2017d. Effort Sharing Decision [online] Available at: <https://ec.europa.eu/clima/policies/effort_en> [Accessed at 19 March 2017].

European Commission. 2017e. Energy Security Strategy [online] Available at: <https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/energy-security-strategy> [Accessed at 16 March 2017].

European Commission. 2017f. Energy Strategy and Energy Union. [online] Available at: <http://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union > [Accessed at 17 March 2017].

European Commission. 2017g. Renewable Energy Progress Report [pdf] Available at <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52017DC0057&qid=1488449105433&from=EN> [Accessed at 18 March 2017].

European Commission. 2017h. Renewables: Europe on track to reach its 20% target by 2020 [online] Available at: <http://europa.eu/rapid/press-release_MEMO-17-163_en.htm#_ftn7> [Accessed at 20 March 2017].

European Commission. 2017i. Second Report on the State of the Energy Union [pdf] Available at: <https://ec.europa.eu/commission/sites/beta-political/files/annex2-2nd-report-state-energy.union_en.pdf> [Accessed at 18 March 2017].

European Commission, 2017j. The EU Emissions Trading System (EU ETS) [online] Available at: <https://ec.europa.eu/clima/policies/ets_en> [Accessed at 19 March 2017].

European Commission. 2017l. National Action Plans - Portugal. [online] Available at: <https://ec.europa.eu/energy/en/topics/renewable-energy/national-action-plans> [Accessed at 28 March 2017].

European Commission. 2017m. EU well on the way to meeting 2020 renewable energy target[online] Available at: <https://ec.europa.eu/energy/en/news/eu-well-way-meeting-2020-renewable-energy-target> [Accessed at 28 March 2017].

Eurostat, 2014. Complete energy balances - annual data. [online] Available at: <http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_110a&lang=en> [Accessed at 16 January 2017].

Eurostat. 2016. Energy, transport and environment indicators – 2016 Edition [pdf] Available at: <http://ec.europa.eu/eurostat/documents/3217494/7731525/KS-DK-16-001-EN-N.pdf/cc2b4de7-146c-4254-9521-dcbd6e6fafa6> [Accessed at 18 March 2017].

Fernandes, C., 2015. Potencialidades e desafios da Bacia do Cáspio para a Estratégia Europeia de aprovisionamento. Oportunidades para Portugal. *Relações Internacionais* (46), 83-99.

Gomes, Carla A. et al. 2016. O Direito da Energia em Portugal: cinco questões sobre "o estado da arte". Instituto de Ciências Jurídico-Políticas / Centro de Investigação em Direito Público. [pdf] Available at: <http://www.mlgts.pt/xms/files/Publicacoes/Artigos/2016/O_Direito_da_Energia_em_Portugal_cinco_questoes_sobre_o_estado_da_arte.pdf> [Accessed at 4 March 2017].

IEA. 2016. Energy Policy of IEA Countries – Portugal 2016 Review. International Energy Agency [pdf] Available at: https://www.iea.org/publications/freepublications/publication/Energy_Policies_of_IEA_Countries_Portugal_2016_Review.pdf> [Accessed at 21 March 2017].

Leal, C. 2014. Energy Security: Concepts, Shifting Energy Landscape and Main Players in the 21st Century. *Globalization and international security. An overview* (Rodrigues, T, Ferreira, S., García, R.). Nova Iorque: NOVA Publishers, Col. Defense, Security and Strategies

Observador. 2016. Portugal usou apenas energias renováveis durante quatro dias consecutivos. [online] Available at: <http://observador.pt/2016/05/18/portugal-usou-apenas-energias-renovaveis-durante-quatro-dias-consecutivos/> [Accessed at 5 March 2017].

República Portuguesa, Programa do XXI Governo Constitucional. [pdf] Available at: <http://www.portugal.gov.pt/pt/o-governo/prog-gc21/20151127-programa.aspx> [Accessed at 21 January 2017].

Resolução da Assembleia da República n.º 33/2010. Diário da República, 1.ª série — N.º 73 — 15 de Abril de 2010. [pdf] Available at: <http://www.apren.pt/fotos/editor2/destaques/rcm_29_2010.pdf> [Accessed at 18 January 2017].

Resolução do Conselho de Ministros nº169/2005. Diário da República, Série B, Nº204, 24 de Outubro 2005, 6168. [pdf] Available at: <https://dre.pt/application/dir/pdf1sdip/2005/10/204B00/61686176.PDF> [Accessed at 29 January 2017].

Resolução do Conselho de Ministros n.º 29/2010, de 15 de Abril de 2010. Diário da República, 1.ª série, Nº73, 15 de Abril de 2010, 1289. [pdf] Available at: <http://www.apren.pt/pt/dadostecnicos/index.php?id=206&cat=197> [Accessed at 18 January 2017].

Rodrigues, T., Campos, A. (2017). Portugal e a segurança energética. Retrato atual e cenários futuros possíveis. IPRI, *Working Paper Series - A Geopolítica do Gás e o Futuro da relação Euro-Russa* 1 [pdf] Available at: <http://geo4ger.wixsite.com/projetogeo4ger/working-papers> [Accessed at 18 March 2017].

Rodrigues, T., Leal, C., Ribeiro, J.. (2012). Elementos para uma Estratégia de Segurança Energética para o Século XXI. Atena 27. Lisboa: IDN.

Silva, A. Costa. 2012. Estratégia Nacional de Segurança e de Defesa: a Energia. Contributos para um Conceito Estratégico de Defesa Nacional, nº 28 da coleção Atena. Lisboa: Imprensa Nacional-Casa da Moeda/IDN

Silva, A. Costa, Rodrigues, T. 2015. Que modelo de segurança energética? Relações Internacionais, nº46, Lisboa: IPRI-UNL.5-10.

Viana, V. (org). 2014. Portugal, a Geopolítica da Energia e a Segurança Energética Europeia. *Policy Paper* 5. Lisboa. IDN [online] Available at: <http://www.idn.gov.pt/conteudos/documentos/e-briefing_papers/policy_paper_5_geopolitica_da_energia_seguranca%20_energetica_da_europa.pdf> [Accessed at 18 January 2017].